

6.0 METEOROLOGY AND AMBIENT AIR QUALITY

6.1 SOURCES OF METEOROLOGICAL DATA

Different meteorological data are available in various forms. Table 6-1 presents the typical meteorological information available from different sources.

One source of meteorological data used is the three dimensional gridded data produced by the Fifth Generation Penn State/NCAR (National Centre for Atmospheric Research) Mesoscale Model, known as MM5. The MM5 model output consist of hourly values of wind speed, wind direction, temperature and pressure on a grid that covers the entire continental United States, southern Canada, and northern Mexico. The MM5 data on a 108-km grid are available for the year 1996. In vertical, this data set has 23 levels (23 sigma l levels). The 1996 data were used in the simulations to allow inclusion of the MM5 datasets in the modelling. The MM5 data were used as the initial guess for the gridded wind fields. These wind fields are assimilated with the measured wind data and adjusted according to terrain and landuse.

The CALMET simulations used the three-dimensional gridded MM5 data along with available surface observations and upper air soundings for a one year period (Figure 5-1). Table 6-3 and Table 6-5 list the surface and upper air sounding stations included in the modelling. The 5 hourly surface meteorological stations (hourly observations) and 2 upper air stations (twice daily observations) within or near the proposed modelling domain were used in CALMET. Buffalo, New York was used as the primary upper air station and missing data were filled in from Gaylord, Michigan generating a single complete upper air station.

Table 6-1 Meteorological Data Sources and Parameters Available

Type of Dataset	Frequency	Source	Parameters
Surface	Hourly	MSC	Wind speed, wind direction, air temperature, ceiling height, cloud cover, relative humidity, surface pressure, precipitation type
Upper Air	Twice-daily	MSC/NWS	Soundings of wind speed, wind direction, temperature and pressure
Modelled Profiles	Hourly	Produced by MM5	Gridded fields of winds, temperature, pressure and humidity
Buoy Data	Hourly	NOAA and NWRI	Lake temperature and winds

MSC – Meteorological Service of Canada

NWS – National Weather Service

MM5 – Mesoscale Model Version 5

NOAA – National Oceanic & Atmospheric Administration

NWRI – National Water Research Institute

Table 6-3 MSC Hourly Surface Stations

Station Name	Station #	Latitude (deg. North)	Longitude (deg. West)
Hamilton A	6153194	43.17	79.93
St. Catharines A	6137287	43.20	79.17
Toronto Lester B. Pearson Int'l	6158733	43.67	79.60
Toronto Buttonville Airport	615HMAK	43.87	79.37
Toronto Island Airport	6158665	43.62	79.38

Table 6-5 Upper Air Stations

Station #	Station Name	Latitude (deg. North)	Longitude (deg. West)
04830	Buffalo, NY	42.70	83.47
04837	Gaylord, MI	44.55	84.43

Lake temperature and measured wind speed and direction were used to account for lakebreeze effects. Buoy data along Lake Ontario were obtained from the NOAA National Buoy Data Centre (NBDC) and National Water Research Institute (NWRI), as shown on Table 6-7. NBDC and Environment Canada operate and maintain the buoys. Data for 1996 were retrieved and formatted for use by CALMET.

Appendix D presents the CALMET computational parameters and switches.

Table 6-7 Buoy Data within Computational Domain

Station No.	Station Name	Latitude (deg. North)	Longitude (deg. West)
C45139	West Lake Ontario, ON	43.427	79.382

6.1.1 METEOROLOGICAL ANALYSIS

The 1996 predicted meteorological data were compared to a longer term dataset (1996-2000) in Zorix (2001) and found to be consistent and representative.

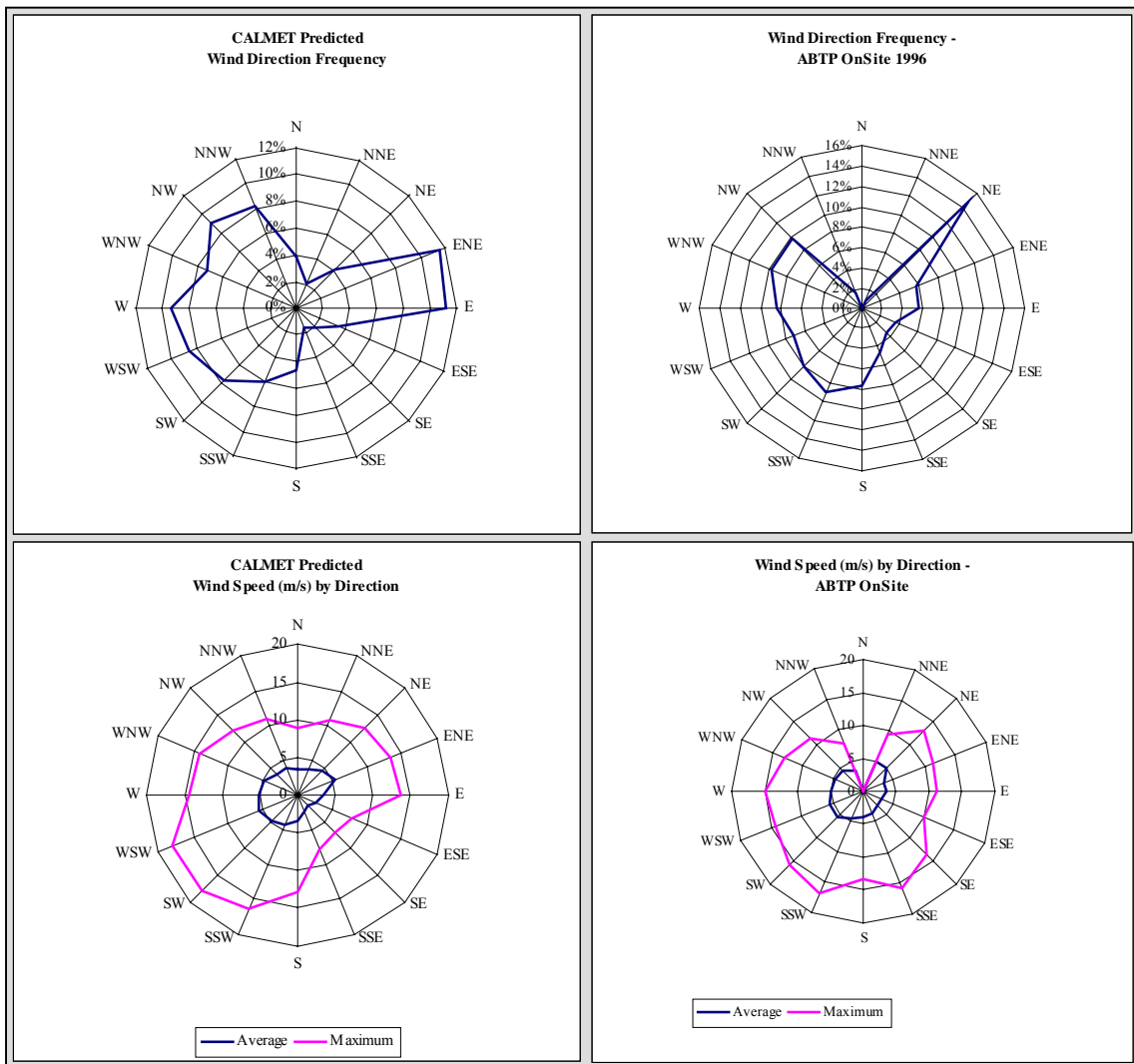
The CALMET predicted winds were also compared with measurements taken at the ABTP for 1996 (Figure 6-1). The ABTP meteorological tower was not used in the meteorological modelling. It is not a fully functional meteorological wind tower which meets Environment Canada requirements but it does provide a degree of comparison between the predicted and on-site measurements.

As shown in Figure 6-1, the wind direction frequencies are similar between measured and predicted. Both data sets show a lack of winds from the north, which is due to the blockage of the City of Toronto urban core but the ABTP measured data show an approximate 20° counter-clockwise rotation in wind direction. Subsequent investigation by the Project Team staff found that the tower is not properly aligned

with true north, by about 20° to the west. Rotating the wind speed summaries at ABTP also shows some consistency between the wind speed roses. This suggests that the model results are representative of the area.

In summary, the winds around the ABTP are strongly influenced by the City of Toronto which causes some blockage of the winds. In addition, winds are stronger from the southwest quadrant and slower from the southeast quadrant. This will tend to cause the emissions from a higher stack to impact to the northeast because of stack tip downwash and lower plume rise. The lower winds from the southeast will likely cause emissions from the lower elevations sources or area sources to have an impact to the northwest. .

Figure 6-1 Comparison of CALMET Wind Rose with ABTP Wind Rose – 1996



6.2 AIR QUALITY DATA

Environment Canada/MOE operate and maintain ambient air quality monitoring stations in the City. Table 6-9 presents a list of stations within the City along with their monitoring parameters between 1995 - 2002. Although none of these stations are within South Riverdale and the Beaches, they do provide a relative measure of air quality in the City and what residents within these two communities are likely exposed to.

A summary of the range of maximum measurements of the Chemicals of Concern over the City is presented in Table 6-11. As shown, not all of the species of concern are measured at the stations during the years of interest. Ambient air quality measurements are below the Ontario AAQC (Table 6-13) but some chemicals (arsenic, benzene, benzo[a]pyrene and cadmium) are above the TPH 24 hour Health Benchmarks. Average ambient air quality observations presented in Table 6-13 were calculated from the mean of the 24-hr average concentrations over each of the scenario periods. Data from all stations for 1995 were used to calculate the Toronto air quality for pre-1996. Similarly, all station data from 2000-2002 were used to calculate the Toronto air quality for 2000-2002. This method does include the contribution of the ABTP to ambient air quality since the ABTP was in operation during these periods of time. The contribution of ABTP to the general air quality can not be easily filtered out from the presented levels.

Table 6-9 Summary of Toronto Air Monitoring Stations with Chemicals of Concern

Station Id	Location	Station Name	Years	Arsenic	Benzene	Benzo(a)pyrene	Cadmium	Hexachlorobutadiene	Lead	NOx	PM _{2.5} (Hr)	PM ₁₀ (24hr)	PM ₁₀ (Hourly)	SO ₂	Total Dioxins and Furans (as 2,3,7,8-TCDD eq)	Total PAH
60403	TORONTO	EVANS & ARNOLD AVE.	I 1995 - 2001	X	X	X	X	X	X	X	X	X	X	X	X	X
60410	TORONTO	LAWRENCE & KENNEDY	R 1995 - 2002								X		X	X		
60413	TORONTO	ELMCREST ROAD	R 1995 - 2002		X			X		X			X	X		
60415	TORONTO	QUEENSWAY W & HURONTARIO	R 1997 - 2002							X	X			X		
60418	TORONTO	RUSKIN & PERTH ST.	C 1995 - 2002		X	X		X							X	X
60419	TORONTO	CN TOWER	C 1995							X	X					
60421	TORONTO	YONGE ST. & FINCH AVE.	C 1995 - 2002							X	X					
60423	TORONTO	CLEARVIEW HEIGHTS	R 1995 - 2000							X						
60424	TORONTO	BAY & WELLESLEY	C 1995 - 2002	X	X		X	X	X	X	X	X		X		
60425	TORONTO	QUEEN & UNIVERSITY	C 1995 - 1998	X			X		X	X		X		X		
60426	TORONTO	MEADOW PK, APPLE LANE C C	I 1996 - 2000		X			X								
60427	TORONTO	223 COLLEGE STREET	C 1999 - 2002	X		X	X		X			X			X	X
60428	TORONTO	525 MAIN ST. N. BRAMPTON	R 2000 - 2002		X			X		X	X			X		
60429	TORONTO	185 JUDSON STREET	R 2001 - 2002	X	X	X	X	X	X	X	X	X	X	X	X	X
60430	TORONTO	125 RESOURCES ROAD	C 2000							X	X		X	X		
61602	OAKVILLE	BRONTE RD. & WOBURN CRES.	R 2001 - 2002		X			X								
63201	STOUFFVILLE	HWY 47 & HWY 48	R 1995 - 2002		X			X								

Note: Not all parameters are measured in every year listed.

Table 6-11 Summary of Chemicals of Concern Ambient Air Monitoring Measurements

		Pre-1996						2000-2002					
		<i>Range of 1hr Max</i>		<i>Range of 24 hr Max</i>		<i>Range of Ann Max</i>		<i>Range of 1hr Max</i>		<i>Range of 24 hr Max</i>		<i>Range of Ann Max</i>	
		(µg/m ³)		(µg/m ³)		(µg/m ³)		(µg/m ³)		(µg/m ³)		(µg/m ³)	
Arsenic	7440-38-2	-	-	0.010	0.003	0.002	0.002	-	-	0.006	0.004	0.002	0.001
Benzene	71-43-2	-	-	13.1	4.66	2.2	1.2	-	-	13.4	1.5	1.7	0.65
Benzo[a]pyrene	50-32-8	-	-	0.00061	0.00061	0.00018	0.00018	-	-	0.00099	0.00015	0.00019	0.00007
Bis(2-ethylhexyl)phthalate	117-81-7	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	7440-43-9	-	-	0.003	0.003	0.003	0.003	-	-	0.004	0.003	0.003	0.003
Di-n-octyl phthalate	117-84-0	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobutadiene	87-68-3	-	-	-	-	-	-	-	-	-	-	-	-
Hydrogen Sulphide	7783-06-4	-	-	-	-	-	-	-	-	-	-	-	-
Lead	7439-92-1	-	-	0.026	0.021	0.009	0.008	-	-	0.042	0.026	0.008	0.004
Mercury	7439-97-6	-	-	-	-	-	-	-	-	-	-	-	-
Nitrogen Oxides	10102-44-0	1,889	472	-	-	133	75	1,848	571	-	-	130	52
PM _{2.5}	N/A-PM	N/A	N/A	-	-	N/A	N/A	142	50	-	-	10	8
PCBs with 4 or More Cl (total)		-	-	-	-	-	-	-	-	-	-	-	-
Sulphur Dioxide	7446-09-5	601	143	-	-	15	8	798	97	-	-	15	8
Total Dioxins and Furans (as 2,3,7,8 TCDD eq)		-	-	N/A	N/A	N/A	N/A	-	-	2.9E-07	3.9E-08	5.6E-08	1.8E-08
Total PAHs		-	-	0.097	0.097	0.037	0.037	-	-	0.200	0.046	0.042	0.019
Vinyl Chloride	75-01-4	-	-	-	-	-	-	-	-	-	-	-	-

Table 6-13 Comparison between Chemicals of Concern Observations and AAQCs/TPH Health Benchmarks

Chemical	CAS Number	AAQC 24 hr ($\mu\text{g}/\text{m}^3$)	Health Benchmark 24 hr ($\mu\text{g}/\text{m}^3$)	Mean Pre-1996	Measured Pre-1996		Mean 2000-2002	Measured 2000-2002	
				(Scenario #1) Air Quality Observations ($\mu\text{g}/\text{m}^3$)	(Scenario #1) Range of 24 hr Max ($\mu\text{g}/\text{m}^3$)		(Scenario #2) Air Quality Observations ($\mu\text{g}/\text{m}^3$)	(Scenario #2) Range of 24 hr Max ($\mu\text{g}/\text{m}^3$)	
Arsenic	7440-38-2	0.3	0.00066	0.002	0.0096	0.0031	0.001	0.0065	0.0039
Benzene	71-43-2		0.3	1.878	13.08	4.66	1.154	13.40	1.51
Benzo[a]pyrene	50-32-8	0.0011	0.000012	0.00018	0.00061	0.00061	0.00012	0.00099	0.00015
Bis(2-ethylhexyl)phthalate	117-81-7	50		-	-	-	-	-	-
Cadmium	7440-43-9	2	0.0006	0.003	0.0033	0.0033	0.003	0.0036	0.0033
Di-n-octyl phthalate	117-84-0	120		-	-	-	-	-	-
Hexachlorobutadiene	87-68-3		1.19	-	-	-	-	-	-
Hydrogen Sulphide	7783-06-4		2 -10	-	-	-	-	-	-
Lead	7439-92-1	2		0.009	0.026	0.021	0.007	0.042	0.026
Mercury	7439-97-6	2.5	0.3	-	-	-	-	-	-
Nitrogen Oxides	10102-44-0	200		104	-	-	78	-	-
PM2.5		30		-	-	-	9	-	-
PCBs with 4 or More Cl (total)		0.15	0.00175	-	-	-	-	-	-
Sulphur Dioxide	7446-09-5	275		11.1	-	-	12	-	-
Total Dioxins and Furans (as 2,3,7,8 TCDD eq)		5.0E-06		-	-	-	3.40E-08	2.90E-07	3.87E-08
Total PAHs				0.037	0.097	0.097	0.026	0.200	0.046
Vinyl Chloride	75-01-4	1	0.1		-	-		-	-

Mean air quality observations were calculated as the mean of the 24-hr average concentrations over the scenario periods of interest. Data from 1995 were used for Pre-1996 levels while data between 2000-2002 was used for Scenario 2.